AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A method of determining a time of flight of a signal transmitted between a transmitter and a receiver, said method comprising the steps of:

~~emitting~~ generating a first ultrasonic signal comprising at least one characteristic waveform feature;

~~emitting~~ generating a second ultrasonic signal comprising at least one corresponding characteristic waveform feature and a waveform modification introduced at a predetermined point in time of the duration of the second ultrasonic signal;

receiving said first and second ~~emitted~~ generated signals;

determining a time of reception of the introduced waveform feature modification in the second ultrasonic signal by comparing the ~~respective waveforms~~ waveform of the first received signal to the waveform of the ~~and~~ second ultrasonic signals and determining a point of diversion between corresponding characteristic waveform features of the first and second received signals comprising super positioning said first and second received signals;

determining a time of flight of the introduced waveform modification based on the determined time of reception of the introduced waveform feature and its time of ~~emission~~ generation.

2. (original): The method of claim 1 wherein the step of determining a point of diversion further comprises:

calculating the difference between a value of the first received signal and a corresponding

value of the second received signal at each point of occurrence of a characteristic waveform

feature within the first received signal;

designating the point of diversion as the first point of occurrence at which the calculated

difference is greater than the value of the second received signal.

3. (currently amended): The method of claim 2 further comprising the step of:

calculating the difference between the time of the point of diversion and the time of

~~emission~~ generation of the introduced waveform feature modification.

4. (currently amended): The method of claim 2 further comprising the steps of:

measuring a time relationship between a nominated characteristic waveform feature and

the point of diversion and;

calculating the difference between the time of reception, based on the measured time

relationship, and the time of ~~emission~~ generation of the nominated characteristic waveform

feature.

5. (currently amended): The method of claim 4 wherein the nominated characteristic

waveform feature is a feature of a first unmodified signal and the method further comprises the

steps of:

~~emitting~~ generating a plurality of subsequent first unmodified signals and;

determining the time of flight of the plurality of subsequent first unmodified signals by

calculating the difference between the time of reception, based on the measured time

relationship, and the time of ~~emission~~ generating of the nominated characteristic waveform

feature of each respective one of the plurality of subsequent first unmodified signals.

6. (currently amended): The method of claim 1 further comprising the step of:

repeating the steps of ~~emitting~~ generating and receiving such that successive first and

second ultrasonic signals are super positioned at the step of determining.

7. (previously presented): The method of claim 1, wherein the characteristic waveform

feature of a signal is one of:

a) a peak;

b) a combination of peaks;

c) a zero-crossing;

d) a combination of zero-crossings.

8. (previously presented): The method of claim 1, wherein the waveform modification is

introduced near the start of a signal.

9. (original): The method of claim 8 wherein the waveform modification is introduced at

one of the third, fourth or fifth waveform peak after the onset of a signal.

10. (previously presented): The method of claim 1, wherein the waveform modification comprises a phase inversion.

11. (canceled).

12. (currently amended): The method of claim ~~11~~ 1, wherein the ultrasonic signals are provided by transducers driven at resonant frequencies in a frequency range of about 60 kHz to about 90 kHz.

13. (previously presented): Apparatus adapted to determine the time of flight of a signal transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method of claim 1.

14. (currently amended): A method of determining a time of flight of a signal transmitted between a transmitter and a receiver, said method comprising the steps of:

~~emitting~~ generating a first and a second ultrasonic signal, where both signals comprise at least one characteristic waveform feature and the second ultrasonic signal further comprises a waveform modification introduced at a predetermined point in time of the duration of the second ultrasonic signal;

receiving said first and second ~~emitted~~ generated signals;

scanning through said the first received ~~signals~~ signal and the second received signal in

time to determine a point of diversion between ~~corresponding~~ a characteristic waveform ~~features~~

feature of the first received signal and a corresponding characteristic waveform feature of the ~~and~~

second received signals, wherein said point of diversion corresponds to a time of reception of the

introduced waveform feature modification at the receiver;

determining the time of flight of the introduced waveform feature on the basis of the time

of reception of the introduced waveform feature and its time of introduction.

15. (original): The method of claim 14 further comprising the steps of:

for each characteristic waveform feature of the first received signal calculating the

difference between a value of the first received signal and a corresponding value of the second

received signal;

designating the first point of occurrence at which the calculated difference is greater than

the value of the second received signal as a point of diversion.

16. (currently amended): The method of claim 15 further comprising the step of:

calculating the difference between the time of the point of diversion and the time of

~~emission~~ generation of the introduced waveform feature modification.

17. (currently amended): The method of claim 15 further comprising the step of:

measuring a time relationship between a nominated characteristic waveform feature and

the point of diversion and calculating the difference between the time of reception, based on the

measured time relationship, and the time of ~~emission~~ generation of the nominated

characteristic waveform feature.

18. (currently amended): The method of claim 17 wherein for a plurality of subsequent

~~emitted~~ generated first unmodified signals, the time of flight is determined by:

calculating the difference between the time of reception, based on the measured time

relationship, and the time of ~~emission~~ generation of the nominated characteristic

waveform feature of respective subsequent first unmodified signals without reference to the point

of diversion.

19. (original): The method of claim 18 wherein the nominated characteristic waveform

feature of the respective subsequent signals is tracked to allow for variations in arrival time due

to physical changes in the transport medium between the transmitter and receiver.

20. (previously presented): Apparatus adapted to determine the time of flight of a signal

transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method of

claim 14.

21. (currently amended): The method of claim 1 further comprising the steps of:

selecting a characteristic waveform feature of a first ultrasonic signal in accordance with

predetermined selection criteria based on the point of diversion;

emitting generating and receiving a plurality of first ultrasonic signals;

detecting zero-crossings of the received plurality of first ultrasonic signals which indicate

the presence of the selected characteristic waveform feature in each of the received plurality of

first ultrasonic signals;

estimating a position of the selected characteristic waveform feature of the received

plurality of first ultrasonic signals in accordance with predetermined estimation criteria based on

the detected zero crossings to provide a position estimation value;

processing the position estimation value to determine a corresponding estimation time;

calculating the time of arrival of the selected characteristic waveform feature of at least

one of the received plurality of first ultrasonic signals by adding a predetermined delay time to

the estimation time.

22. (original): The method of claim 21 wherein the predetermined selection criteria

comprise one of:

a) adding a predefined delay to the time of the point of diversion;

b) subtracting a predefined delay from the time of the point of diversion.

23. (previously presented): The method of claim 21 wherein the predetermined

estimation criteria comprise:

a) measuring the time of zero-crossings adjacent the selected characteristic waveform

feature and;

b) averaging the measured time of zero-crossings.

24. (currently amended): Apparatus adapted to determine the time of flight of a signal

transmitted between a transmitter and a receiver, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the method of

claim 21 wherein said apparatus comprises:

signal transducing means for ~~emitting~~ generating and receiving a plurality of first

ultrasonic signals;

waveform feature selection means operatively connected to the signal transducing means

and the processor means for selecting a characteristic waveform feature of a first ultrasonic

signal in accordance with predetermined selection criteria based on the point of diversion;

zero-crossing detection means operatively connected to transducing means and the

processor means for detecting zero-crossings of the received plurality of first ultrasonic signals

which indicate the presence of the selected characteristic waveform feature in each of the

received plurality of first ultrasonic signals;

signal position estimation means operatively connected to the zero-crossing detection

means and the processor means for estimating a position of the selected characteristic waveform

feature of the plurality of received first ultrasonic signals in accordance with predetermined

estimation criteria based on the detected zero-crossings to provide a position estimation value;

wherein the processor means processes the position estimation value to determine a

corresponding estimation time and calculates the time of arrival of the selected characteristic

waveform feature of at least one of the plurality of received first ultrasonic signals by adding a

predetermined delay time to the estimation time.

25. (original): The apparatus of claim 24 wherein said signal position estimation means

comprises a dual slope integrator.

26. (currently amended): The apparatus of claim 24 wherein said plurality of received

first ultrasonic signals are digitised and said processor means comprises digital data processing

means comprising said zero-crossing detection means and said signal position estimation means.

27. (currently amended): A method of monitoring flow through a particle detector of an

aspirated smoke detector system, the method comprising the steps of:

ascertaining the base flow of fluid through a particle detector using a flow sensor;

monitoring subsequent flow through the particle detector;

comparing the subsequent flow with the base flow, and indicating a fault if the difference

between the base flow and the subsequent flow exceeds a predetermined threshold wherein base

flow and subsequent flow are determined at respective times according to the following general

flow calculation:

$f = S \times A$

where f = volumetric flow;

A = cross sectional area of an air flow path through the detector system;

s = speed of air through the detector system such that s is given by;

$$s = \frac{d}{2}\left(\frac{1}{t_2} - \frac{1}{t_1}\right)$$

where t_2 is the transit time of a signal transmitted in a forward direction, being generally

in the direction of flow, from a first transducer located adjacent the flow path to a second

transducer located generally opposite the first transducer and adjacent the flow path;

~~t_2~~ t_2 is the transit time of a signal transmitted in a reverse direction, being generally

against the direction of flow, from the second transducer to the first transducer;

d is a distance travelled by the signal between the first and second transducer;

and wherein both t_1 and t_2 are determined in accordance with the method of claim 1.

28. (original): Apparatus adapted to monitor flow through a particle detector of an

aspirated smoke detector system, said apparatus comprising:

processor means adapted to operate in accordance with a predetermined instruction set,

said apparatus, in conjunction with said instruction set, being adapted to perform the

method of claim 27.

29. (currently amended): A method of detecting one or more blocked sampling holes in a

pipe of an aspirated smoke detector system, said method comprising:

ascertaining the base flow of fluid through a particle detector using a flow sensor of said

aspirated smoke detector system, said aspirated smoke detector system comprising a sampling

network including one or more sampling holes, an aspirator for drawing sir through the sampling network to the detector; and thea flow sensor;

monitoring subsequent flow through the particle detector using the flow sensor;

comparing the subsequent flow with the base flow, and determining that one or more sampling holes of the sampling network are blocked and indicating a fault, if the difference between the base flow and the subsequent flow exceeds a predetermined threshold.

30. (original): The method of claim 29 wherein the flow sensor is an ultrasonic flow sensor.

31. (canceled).

32. (currently amended): The method of claim 29, wherein the difference between base flow and 30-subsequent flow is compared over a length of time.

33. (currently amended): The method of claim 29 wherein the flow is determined according to the following general flow calculation:

$f=s \times A$

where f = volumetric flow;

A = cross sectional area of an air flow path through the detector system;

s = speed of air through the detector system such that s is given by;

$$s = \frac{d}{2}\left(\frac{1}{t_2} - \frac{1}{t_1}\right)$$

where t, is the transit time of a signal transmitted in a forward direction, being generally in the direction of flow, from a first transducer located adjacent the flow path to a second transducer located generally opposite the first transducer and adjacent the flow path;

t_2 is the transit time of a signal transmitted in a reverse direction, being generally against the direction of flow, from the second transducer to the first transducer;

d is a distance travelled by the signal between the first and second transducer;

and wherein both t_1 and t_2 are determined.

34. (currently amended): An aspirated smoke detector comprising:

a particle detector,

a sampling network including one or more sampling points; and

an aspirator for drawing air through the sampling network to the detector,

an inlet,

an outlet; and

a-an ultrasonic flow sensor, wherein the flow sensor uses ultrasonic waves in fluid arranged to detect the flow rate of air entering the particle detector.

35. (currently amended): The detector of claim 34 wherein the flow sensor is in fluid communication with the sampling network and is operationally arranged to measures-measure the partial flow of fluid through a sampling network.

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36. (previously presented): The smoke detector of claim 34, wherein the particle detector

detects particles in a portion of the air flow flowing through the sampling network.

37. (previously presented): The smoke detector of claim 34 wherein the flow sensor is

located in the sampling network.

38. (previously presented): The smoke detector of claim 34, wherein the flow sensor is

located in a housing for the particle detector.

39. (previously presented): The smoke detector of claim 34, having a branch in the inlet

allowing air to bypass the particle detector.

40. (canceled).

41. (previously presented): A computer program product comprising:

a computer usable medium having computer readable program code and computer

readable system code embodied on said medium for determining the time of flight of a signal

transmitted between a transmitter and a receiver within a data processing system, said computer

program product comprising:

computer readable code within said computer usable medium for performing the method

steps of claim 1.

42. (original): A computer program product comprising:

a computer usable medium having computer readable program code and computer

readable system code embodied on said medium for monitoring flow through a particle detector

of an aspirated smoke detector system within a data processing system, said computer program

product comprising:

computer readable code within said computer usable medium for performing the method

steps of claim 27.

43. (previously presented): A computer program product comprising:

a computer usable medium having computer readable program code and computer

readable system code embodied on said medium for detecting one or more blocked sampling

holes in a pipe of an aspirated smoke detector system within a data processing system, said

computer program product comprising:

computer readable code within said computer usable medium for performing the method

steps of claim 29.

44- 45. (canceled).

46. (currently amended): A method of determining the time of flight of a signal

transmitted between a transmitter and a receiver, said method comprising the steps of:

~~emitting~~ generating a first ultrasonic signal comprising at least one characteristic

waveform feature;

~~emitting~~ generating a second ultrasonic signal comprising at least one characteristic

waveform feature and a waveform modification introduced at a predetermined point in time of

the duration of the second ultrasonic signal;

receiving said first and second ~~emitted~~ generated signals;

determining a point of diversion between corresponding characteristic waveform features

of the first and second received signals comprising super positioning said first and second

received signals such that said point of diversion corresponds to an arrival time of the introduced

waveform feature modification at the receiver, wherein the step of determining a point of

diversion further comprises:

calculating the difference between a value of the first received signal at a time and a

~~corresponding~~ value of the second received signal at a corresponding time for each point of

occurrence of ~~a~~ the characteristic waveform feature within the first received signal;

designating the point of diversion as the first point of occurrence at which the calculated

difference is greater than the value of the second received signal and wherein the method further

comprises measuring a time relationship between a nominated characteristic waveform feature

and the point of diversion and;

calculating the difference between the time of reception, based on the measured time

relationship, and the time of ~~emission~~ generation of the nominated characteristic waveform

feature and wherein the nominated characteristic waveform feature is a feature of a first

unmodified signal and the method further comprises the steps of:

emitting generating a plurality of subsequent first unmodified signals and;

determining the time of flight of the plurality of subsequent first unmodified signals by

calculating the difference between the time of reception, based on the measured time

relationship, and the time of emission generation of the nominated characteristic waveform

feature of each respective one of the plurality of subsequent first unmodified signals.